LOW COST APPROACH FOR DECHLORINATION

Richard Grubbs[1] and Tom Ladshaw[2]

AUTHOR: [1]Water Reclamation Plant Manager and [2]Electronics Coordinator, Gwinnett County Department of Public Utilities, 75 Langley Drive, Lawrenceville, Georgia 30245.
REFERENCE: Proceedings of the 1991 Georgia Water Resources Conference, held March 19 and 20, 1991, at The University of Georgia, Kathryn J. Hatcher, Editor, Institute of Natural Resources, The University of Georgia, Athens, Georgia.

INTRODUCTION

Chlorine has been used for many years to treat municipal and industrial water and wastewater. The basic reasons for using chlorine in the treatment of wastewater is the destruction of inherent pathogenic organisms, bacteria and viruses to prevent the spread of disease by water borne agents.

However, there is increasing concern and regulation over the levels of residual chlorine in wastewaters that are discharged to the receiving streams. Current regulatory agencies are examining the effect of residual chlorine and chlorinated compounds in water on human and aquatic life.

It is not always possible to maintain a low chlorine residual by dose alone. Breakpoint chlorination and wastes with high chlorine demand (for adequate disinfection) may result in a high chlorine discharge. Therefore, it may be necessary to use dechlorination agents to reduce or eliminate residual chlorine levels in wastewaters.

Gwinnett County has been concerned about the effects of the potentially toxic nature of chlorine in the treatment plant effluent and its effects on the aquatic life found in the receiving streams.

The work that Gwinnett County has done in the past year in constructing a delivery system for sodium thiosulfate shows one means of addressing the dechlorination of wastewater without considerable capital outlay. Other municipalities have study the system that we have installed and are making plans to have a similar system designed because they are to receive new chlorine limits on their N.P.D.E.S. Permits when they are reissued.

METHODS

Even without EPD imposed chlorine limits, Gwinnett County determined that we needed to explore the possibility of dechlorination at all the facilities within the county to protect the receiving streams. Realizing that we could not afford large capital costs for these projects and being limited on available space within our existing facilities, we needed to design and construct a low cost delivery system.

Several dechlorinating techniques were available . Aeration could be used to drive out some residual chlorine, although low levels of residual chlorine using this technique is not likely. Activated carbon has been suggested. Sulfur dioxide and sulfur dioxide-containing compounds, such as sodium thiosulfate, ammonium bisulfite solution and ammonium thiosulfate solution are all effective dechlorination agents.

Sulfur dioxide is a compressed toxic gas and requires a more intricate feeding system than required for the liquid or solid products. Liquified sulfur dioxide is usually utilized only in very large treatment systems. Also storage of large quantities of liquified sulfur dioxide in heavily populated areas pose a serious threat in case of a leak.

In our efforts to effect dechlorination, we investigated ways and chemicals to accomplish dechlorination without large capital cost and the use of hazardous chemicals. We used the results of the dechlorination studies done by the Syracuse Research Laboratory in June, 1984. This study showed the dechlorination of tap water containing 18 ppm chlorine was accomplished with the quantities of materials listed in Table 1. Complete dechlorination was accomplished within two minutes at 25 degree C. A residual chlorine electrode was used to analyze for chlorine.

In this work, the results with sodium thiosulfate, pH has an effect on the required quantities of dechlorinating agent.

TABLE I
CHEMICALS USED IN DECHLORINATION

Parts required per part of chlorine removed

Dechlorinating Agent	pH 4.0	pH 6.5	pH 9.0	pH 11.0
Sodium Sulfite	1.96	1.96	1.96	1.96
Sodium Bisulfite	1.61	1.61	1.61	1.61
Sodium Thiosulfate	2.67	2.23	1.60	1.00

Typically wastewater is maintained around a pH 7.

CONCLUSIONS

The Yellow River/Sweetwater Creek facility was upgraded in 1988 from 6 MGD to 12 MGD which included carbon filters and dechlorination with sulfur dioxide. The capital cost for installing the dechlorination process was in excess of $350,000.

Realizing that we could not afford to expend this amount of monies at our existing facilities we looked for an alternate method of dechlorination.

We considered sodium thiosulfate and sodium bisulfite as chemicals to accomplish dechlorination. Sodium bisulfite was found to omit poisonous gases when it encountered water and could be harmful to the plant operators.

Sodium thiosulfate was chosen as the chemical agent that we would use for the following reasons:

1. No poisonous gases.
2. Mixed readily with water.
3. Less likely to overdose effluent which could cause an oxygen depletion in the receiving stream.

4. Instant reaction with chlorine.
5. Initial capital investment.

A solution of sodium thiosulfate (50#'s to 200 gallons of water) is fed to the chlorinated effluent at the Jackson Creek facility, by way of an injection point located in a manhole just after the chlorine contact chamber.

The systems which have been installed in Gwinnett County have proved that the sodium thiosulfate will consistently reduce the chlorine residuals to within the mandated range. However, when we first received the new N.P.D.E.S. Permits giving us a limit of 0.013 mg/l, we found that we were not able to accurately read to this limit. We called upon our contral laboratory to work with us and the State to come up with a limit which could be monitored at the facility with the Hach DR-2000 spectrometer. The Permit was then revised with a new limit of .15 mg/l.

The major drawbacks of our systems as presently installed lie in the reliability for continuous operation: (1) we did not install backup metering equipment, (2) using a dry product, we need two tanks and a transfer pump: one tank to mix in and a smaller one to feed from. Also, using a dry bagged product means that someone has to unload trucks, there must be adequate storage for the bags, someone has to mix the solution and injuries/strains are always possible when lifting/handling the product.

A Wallace and Tiernan chemical pump provides variable speed operation and the solution can be pumped at an adjustable rate between 0 to 800 gallons of solution per day. A dosage control and local speed indicator provide the operator with information to precisely regulate the dechlorination system in regards to the plant flows.

TABLE 2
FACTS ON DECHLORINATION WITH SODIUM THIOSULFATE

1. Cost of sodium thiosulfate $.3429/lb.
2. Cost $6.75/MG.
3. 104 pounds of chlorine removed each day.
4. 100 pounds of sodium thiosulfate used each day.
5. Average chlorine residual before dechlorination .55.
6. Average chlorine residual after dechlorination .05.
7. Target for fecal 50.

TABLE 3
EQUIPMENT USED

ITEM	COST
44-133 Wallace & Tiernan pump with 1/2 HP D.C. motor and tachometer assembly.	$1,800
340 gallon fiberglass tank/cover with 3/4 HP mixer/motor.	2,900
Control panel - Electronic Staff design features manual and 2 stage auto feed rate controller with % speed meter with mixer control.	775
Electrical panel with local disconnect and 480/120 power transformer.	350
Lines and fittings (PVC).	400
Electrical	275
Total cost of materials	$6,500

LITERATURE CITED

The Technology Exchange, No. 2
Spring 1984
The Water Technology Group
536 South Main St., Highstown, N.J. 08520